

Mark Scheme (Results)

June 2012

Methods in Mathematics (GCSE)
Unit 2: Methods 5MM2H_01

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NOTES ON MARKING PRINCIPLES

- 1 All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- 2 Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- 3 All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- 4 Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- 5 Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- 6 Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:
 - i) *ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear*
Comprehension and meaning is clear by using correct notation and labeling conventions.
 - ii) *select and use a form and style of writing appropriate to purpose and to complex subject matter*
Reasoning, explanation or argument is correct and appropriately structured to convey mathematical reasoning.
 - iii) *organise information clearly and coherently, using specialist vocabulary when appropriate.*
The mathematical methods and processes used are coherently and clearly organised and the appropriate mathematical vocabulary used.

7 With working

If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

If it is clear from the working that the “correct” answer has been obtained from incorrect working, award 0 marks. Send the response to review, and discuss each of these situations with your Team Leader.

If there is no answer on the answer line then check the working for an obvious answer.

Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks. Discuss each of these situations with your Team Leader.

If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.

8 Follow through marks

Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.

Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

9 Ignoring subsequent work

It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: e.g. incorrect canceling of a fraction that would otherwise be correct

It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect e.g. algebra.

Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

10 Probability

Probability answers must be given as fractions, percentages or decimals. If a candidate gives a decimal equivalent to a probability, this should be written to at least 2 decimal places (unless tenths).

Incorrect notation should lose the accuracy marks, but be awarded any implied method marks.

If a probability answer is given on the answer line using both incorrect and correct notation, award the marks.

If a probability fraction is given then cancelled incorrectly, ignore the incorrectly cancelled answer.

11 Linear equations

Full marks can be gained if the solution alone is given on the answer line, or otherwise unambiguously indicated in working (without contradiction elsewhere). Where the correct solution only is shown substituted, but not identified as the solution, the accuracy mark is lost but any method marks can be awarded.

12 Parts of questions

Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

13 Range of answers

Unless otherwise stated, when an answer is given as a range (e.g 3.5 – 4.2) then this is inclusive of the end points (e.g 3.5, 4.2) and includes all numbers within the range (e.g 4, 4.1)

Guidance on the use of codes within this mark scheme

M1 – method mark
A1 – accuracy mark
B1 – Working mark
C1 – communication mark
QWC – quality of written communication
oe – or equivalent
cao – correct answer only
ft – follow through
sc – special case
dep – dependent (on a previous mark or conclusion)
indep – independent
isw – ignore subsequent working

5MM2H_01					
Question		Working	Answer	Mark	Notes
1		$\frac{8.64}{8.8543...} =$	0.9757885...	2	M1 any one of 8.64 or 8.85... or 0.975 or 0.976 or 0.97 or 0.98 seen A1 0.9757(8...)
2		$C = \pi \times 10$	31.4 cm	2	M1 for $\pi \times 10$ or $2 \times \pi \times 5$ A1 for 31.4 – 31.42
3		$\frac{1}{2} \left(\frac{1}{2} + \frac{1}{4} \right) = \frac{1}{2} \times \frac{2+1}{4} = \frac{3}{8}$ <p>Or</p> $\frac{1}{2} - \frac{1}{4} = \frac{2-1}{4} = \frac{1}{4}$ $\frac{1}{4} + \frac{1}{4} \div 2 = \frac{1}{4} + \frac{1}{8} = \frac{3}{8}$ <p>Or</p> $\frac{1}{2} = \frac{4}{8}, \frac{1}{4} = \frac{2}{8}$	$\frac{3}{8}$	3	<p>M1 $\frac{1}{2} + \frac{1}{4}$ oe or 0.5+0.25 or 50+25 M1 $\frac{1}{2} \left(\frac{1}{2} + \frac{1}{4} \right)$ oe or '0.75' ÷ 2 or '75' ÷ 2 A1 $\frac{3}{8}$ oe</p> <p>Or</p> <p>M1 $\frac{1}{2} - \frac{1}{4}$ oe or 0.5-0.25 or 50-25 M1 $\frac{1}{4} + \frac{1}{4} \div 2$ or 0.25+ '(0.25' ÷ 2) or 25% + '(50-25' ÷ 2)' % oe with percentage sign A1 $\frac{3}{8}$ oe</p> <p>OR</p> <p>M1 change both fractions to 8ths M1 '(4+2)' ÷ 2 or '$(\frac{4}{8} + \frac{2}{8})$' ÷ 2 A1 $\frac{3}{8}$ oe</p> <p>SC B1 for (37 + 38)/2 or 37.5</p>

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Question		Working	Answer	Mark	Notes
4		$3 + 5 = 8$ $100 \div 8 = 12.5$ $12.5 \times 3 = 37.5$ Or $\frac{3}{8} \times 100$	37.5%	2	M1 $3 + 5 = 8$ and $100 \div 8$ or $30 + 50 = 80$ and $100 \div 80 \times 30$ A1 cao Or M1 $\frac{3}{8} \times 100$ or $\frac{30}{80} \times 100$ oe A1 cao SC B1 for 62.5
5			-3, -2, -1, 0, 1	2	B2 -3, -2, -1, 0, 1 (B1 condone one error or omission e.g. -2, -1, 0, 1 or -3, -2, -1, 0, 1, 2)
6	(a)	A: x B: $x + 4$ $x + x + 4$	$T = 2x + 4$	3	B3 for $T = 2x + 4$ oe (B2 for $2x + 4$ oe or for $T = 2x + b$ where $b \neq 0$ or $T = ax + 4$ where a not equal to 0 (B1 for $x + 4$ or for $T =$ any expression)
	(b)	$2 \times 13 + 4$ Or $13 + 17$	30	2	M1 ft from their formula in the form $ax + b$ when a and $b \neq 0$ A1 ft Or M1 $13 + 13 + 4$ A1
7	(a)(i)		72°	2	B1 for 72°
	(ii)		Alternate angles	2	B1 for <u>alternate</u> angles
	(b)	$180^\circ - 53^\circ$	127°		M1 $180^\circ - 53^\circ$ A1 cao OR M1 $180 - (360 - "72" - (180 - 72) - (180 - 53))$ A1 cao

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Question		Working	Answer	Mark	Notes
8		$1640 \times \frac{30}{100} = 492$ $1640 \div 10 = 164$ $492 + 164 + 550 = 1206$ $1640 - 1206 = 434$ Or $1640 \times \frac{40}{100} = 656, 656 + 550 = 1206$ $1640 - 1206 = 434$	Yes	5	M1 for attempting to find the area of one section (blue or yellow) M1 for attempting to find the area of the second section (yellow or blue) or award M2 for attempt to find the combined area of blue and yellow) M1 for attempting to find the total area of three sections or four sections using white as 400 or subtracting the 3 sections from 1640 A1 1206 or 434 or 1606 C1 dep on at least M1 for correct conclusion based upon their calculations relating their white area to 400 or “1206” to 1240 or “1606” to 1640
9	(a)		120°	1	B1 cao
	(b)	$90 + 120 = 210$ $360 - 210 = 150$ Ext angle = 30 No of sides = $360 \div 30 = 12$	12	3	M1 $360 - (“120” + 90) = 150$ M1 (dep on M1) for ext angle = $180 - “150”$ A1 cao
10		$120 \div 0.3$ Or $30\% = 120$ $\frac{120}{30} \times 100$ Or $10\% = 40$ $10 \times 40 = 400$ Or $10\% = 40,$ $120 + 120 + 120 + 40$	400	3	M2 for $120 \div 0.3$ or $\frac{120}{30} \times 100$ or $10\% = 40$ and 10×40 or $120 + 120 + 120 + 40$) (M1 for $30\% = 120$ or $10\% = 40$ oe A1 cao

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Question		Working					Answer	Mark	Notes														
11	(a)	<table border="1"><tr><td>x</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>5</td><td>1</td><td>-1</td><td>-1</td><td>1</td><td>5</td></tr></table>					x	-1	0	1	2	3	4	y	5	1	-1	-1	1	5	5, -1, -1	2	B2 all 3 correct (B1 any 1 correct)
	x						-1	0	1	2	3	4											
	y						5	1	-1	-1	1	5											
(b)		Correct graph	2	B1 ft 5 or 6 points plotted correctly B1 cao for the correct curve																			
	(c)	Draw line $y = 4$					3.8, -0.8	2	M1 ft Draw $y = 4$ or for 3.8 or - 0.8 accept as coordinates A1 ft for both results but not as coordinates														
*12		Slope : $5^2 + 12^2$ $\sqrt{5^2 + 12^2} = 13$ $13 \times 15 = 195$					195 cm ²	5	M1 $5^2 + 12^2$ M1 $\sqrt{5^2 + 12^2}$ or $\sqrt{169}$ A1 13 M1 '13' $\times 15$ C1 cao dep on M1 earned for “195” cm ² where the answer is identified If no working shown SC B3 for 195 cm ² SC B2 for 195														
13	(a)	$x = 1000^{\frac{1}{6}}$					3.16	1	B1 for 3.16 3.1623 (accept $x = 1000^{\frac{1}{6}}$ or $\sqrt[6]{1000}$) B1 (accept $y = 1000^2$ or 10^6														
	(b)	$y = 1000^2$					1000000	1															

5MM2H_01				
Question	Working	Answer	Mark	Notes
14	<p>Area of circle B is 110% of the area of circle A Area of circle C is 110% of 110% = 121% of the area of circle A.</p> <p>Or Area of circle B is 220 cm^2 Area of circle C is 242 cm^2</p> <p>Area of circle B is 1.1 times bigger Area of circle C is $1.1 \times 1.1 = 1.21$ times bigger</p>	21% or 42 cm^2	4	<p>B1 110% seen M1 $\frac{110}{100} \times 110$ oe A1 121% C1 dep on M1 for 21% bigger oe or B1 220 shown M1 $\frac{110}{100} \times 220$ A1 242 C1 dep on M1 for area is 42 cm^2 bigger oe or B1 for 1.1 seen M1 for 1.1×1.1 A1 for 1.21 C1 dep on M1 for 21% larger or 1.21 times larger o.e.</p>
15	<p>Cube $10^3 = 1000$ Cylinder $\pi \times 4^2 \times 10 = 160\pi$ Remainder $1000 - 160\pi = 497$</p> <p>Or Square $10^2 = 100$ Circle $\pi \times 4^2 = 16\pi$ Remaining area = $100 - 16\pi$ Remainder = $(100 - 16\pi) \times 10$</p>	497 cm^3	4	<p>M1 10^3 or sight of 1000 M1 for $\pi \times 4^2 \times 10$ sight of 503 M1 (dep on at least M1) for '1000' - '160π' where both are volumes A1 for 497 – 497.6</p> <p>Or M1 for 10^2 M1 for $\pi \times 4^2$ or 16π M1 (dep on at least M1) for '(100 – 16π)' $\times 10$ where both "100" and "16π" are areas A1 for 497 – 497.6</p>

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Question		Working	Answer	Mark	Notes
16		$20 \times 0.35 = 7$	20	2	B2 for 20 (B1 for any other multiple of 20 or $20 \times 0.35 = 7$)
17	(a)	$y = 4.129 \times 10^7 + 3.2 \times 10^{-2} \times 45000^2$ $= 4.129 \times 10^7 + 6.48 \times 10^7$ $= 106090000$	1.0609×10^8	3	B3 for 106090000 oe (B2 for 64 800 000 or digits 648 seen) (B1 for correct substitution)
	(b)	$y - a = bx^2$ $\frac{y - a}{b} = x^2$ Or $\frac{y}{b} = \frac{a}{b} + x^2$ $\frac{y}{b} - \frac{a}{b} = x^2$	$x = \pm \sqrt{\frac{y - a}{b}}$	2	M1 for either an intention to $-a$ from each side of the formula or to divide each side of the formula by b as a first step in rearranging the formula A1 oe (Condone omission of \pm)

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Question		Working	Answer	Mark	Notes
18	(a)	$\frac{x}{4.8} = \frac{4}{3}$ $x = \frac{4}{3} \times 4.8$ or $4.8 + \frac{1}{3} \times 4.8$	6.4	2	M1 for $\frac{x}{4.8} = \frac{4}{3}$ oe A1 for 6.4 cao Or M1 for $4.8 + \frac{1}{3} \times 4.8$ oe or $4 \times (4.8 \div 3)$ oe A1 for 6.4 cao
	(b)	Area $BCFE$: area $ABED = 4^2:3^2$ Area $BCFE = \frac{16}{9} \times 9.9$	17.6	2	M1 sight of $4^2:3^2$ or $\left(\frac{4}{3}\right)^2$ or $\left(\frac{3}{4}\right)^2$ A1 cao
19	(a)	$9 - 4x = 0$ Or $4x = 9 - 3y$ so $x = \frac{9}{4} - \frac{3}{4}y$	(2.25,0)	2	M1 for writing $9 - 4x = 0$ A1 for (2.25,0) oe (condone missing brackets) or $x = 2.25$ and $y = 0$
	(b)	$3(12 - x) = 9 - 4x$ $36 - 3x = 9 - 4x$ $4x - 3x = 9 - 36$ $x = -27$ Substitute $-27 + y = 12$ $y = 39$	(-27, 39)	4	M1 Sub for x or y or eliminate to get an equation in solely x or y . (Allow one arithmetic error only) A1 $x = -27$ (or $y = 39$) M1(dep) Sub for value of x or y in one equation or starting again A1 $y = 39$ (or $x = -27$)

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Question	Working	Answer	Mark	Notes
20	$\tan(ABC) = \frac{6}{7.5} = 0.8$ $\text{angle } ABC = \tan^{-1}(0.8) = 38.65\dots$ $\text{Angle } DCB = 38.65\dots$ Or $\tan(ACB) = \frac{7.5}{6} = 1.25$ $ACB = \tan^{-1}(1.25) = 51.34\dots$ $\text{Angle } BCD = 90 - 51.34\dots$ Or $AC = \sqrt{6^2 + 7.5^2} = 9.604(686\dots)$ $\sin(ABC) = \frac{6}{9.605} = 0.937$ $\text{angle } ABC = \sin^{-1}(0.937) = 38.65\dots$ $\text{Angle } DCB = 38.65\dots$	38.7	4	$M1 \tan(ABC) = \frac{6}{7.5}$ $M1 \tan^{-1}\left(\frac{6}{7.5}\right)$ $M1 \text{ (indep) Angle } DCB = \text{angle } ABC$ $A1 38.65 - 38.7$ Or $M1 \tan(ACB) = \frac{7.5}{6}$ $M1 \tan^{-1}\left(\frac{7.5}{6}\right) (= 51.34)$ $M1 \text{ (indep) Angle } DCB = 90 - \text{angle } ACB$ $A1 38.65 - 38.7$ Or $M1 \text{ for using sin or cosine to find angle } ABC \text{ or angle } ACB \text{ using } BC = 9.604$ $M1 \text{ for using } \sin^{-1} \text{ of } \cos^{-1} \text{ as appropriate}$ $M1 \text{ (indep) angle } DCB = \text{angle } ABC \text{ or angle } DCB = 90 - 51.34\dots$ $A1 38.65 - 38.7$
21	$y = kx^2 \quad 24 = k \times 2^2 \quad k = 6$ $y = 6 \times 3^2 = 54$	54	4	$M1 y = kx^2 \text{ or for writing } y \propto x^2$ $M1 24 = k \times 2^2$ $A1 k = 6$ $A1 54$

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Question		Working	Answer	Mark	Notes
22		$x = \frac{-10 \pm \sqrt{10^2 - 4 \times 1 \times 7}}{2 \times 1}$ $x = \frac{-10 \pm \sqrt{72}}{2}$ Or $(x+5)^2 - 5^2 + 7 = (x+5)^2 - 18$ $x+5 = \pm\sqrt{18}$	-0.757, -9.24	3	M1 $x = \frac{-10 \pm \sqrt{10^2 - 4 \times 1 \times 7}}{2 \times 1}$ allow errors in sign on 'b' and 'c' M1 $x = \frac{-10 \pm \sqrt{72}}{2}$ A1 -0.75 to -0.76 and -9.2 to -9.3 Or M1 $(x+5)^2 - 5^2 + 7$ M1 $x+5 = \pm\sqrt{18}$ A1 -0.75 to -0.76 and -9.2 to -9.3
23	(a)	$\frac{1}{2} \times 11.6 \times 8.7 \times \sin 52^\circ$	39.8	2	M1 $\frac{1}{2} \times 11.6 \times 8.7 \times \sin 52^\circ$ or complete method to find area using trig and/or Pythagoras and $\frac{1}{2} \text{ base} \times \text{ht}$ A1 39.75 – 39.8
	(b)	$XZ^2 = 8.7^2 + 11.6^2 -$ $2 \times 8.7 \times 11.6 \times \cos 52^\circ$ $= 85.985$	9.27	3	M1 $8.7^2 + 11.6^2 - 2 \times 8.7 \times 11.6 \times \cos 52^\circ$ M1 for correct order of evaluation or 85.985 A1 9.27 – 9.275
24	(a)	Translation of $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$	(1,1)	2	B2 (1, 1) (B1 (5, 1))
	(b)	$(x+2)^2 - 6(x+2) + 10 =$ $x^2 - 2x + 2$	$b = -2$	2	M1 $(x+2)^2 - 6(x+2) + 10$ or uses the minimum point of the translated curve (1, 1) and substitutes into $y = x^2 + bx + 2$ A1 cao

5MM2H_01				
Question	Working	Answer	Mark	Notes
25	$\frac{36}{30} = \frac{18}{15} = \frac{12}{10} = \frac{6}{5}$ <p>Or</p> $y = \frac{36}{30}x, y = \frac{6}{5}x$ $x = 5, y = 6 \text{ etc}$	(5, 6), (10, 12), (15, 18) (20, 24), (25, 30)	3	<p>M1 uses equivalent fractions or ratios e.g. $\frac{36}{30} = \frac{18}{15}$ or 30:36 = 15:18 or states one pair A1 two correct pairs A1 all five correct pairs with no incorrect pairs</p> <p>Or</p> <p>M1 $y = \frac{36}{30}x$ or $y = \frac{6}{5}x$ A1 two correct pairs A1 all five correct pairs with no incorrect pairs</p> <p>NB Ignore (0,0) and (30, 36) if included in their list</p>
26	$y = 2 - 2x$ $y^2 = (2 - 2x)^2 = 4x^2 - 8x + 4$ $x^2 + 4x^2 - 8x + 4 = 1$ $5x^2 - 8x + 3 = 0$ $(5x - 3)(x - 1) = 0$ $x = \frac{3}{5}, 1$ $y = 2 - 2 \times \frac{3}{5} = \frac{4}{5} \text{ or } y = 2 - 2 = 0$	$x = \frac{3}{5}, y = \frac{4}{5}$ $x = 1, y = 0$	7	<p>B1 $y = 2 - 2x$ M1 for $x^2 + "(2 - 2x)^2"$ (=1) B1 for $x^2 + "4x^2 - 8x + 4"$ M1 Collect to 3 term quadratic M1 for attempt to factorise or correct substitution into formula</p> <p>A1 $x = \frac{3}{5}, 1$ A1 $y = \frac{4}{5}, 0$</p> <p>SC B1 for $x = 1$ and $y = 0$ or 3/5 and 4/5</p>

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